MONTANA STATE AIRPORT SYSTEM PLAN

SUMMARY

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MONTANA STATE
AIRPORT SYSTEM PLAN

SUMMARY

July, 1974

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PREFACE

The Montana State Airport System Plan, prepared by Knoerle, Bender, Stone and Associates, Inc. and Airways Engineering Corporation, is comprised of five volumes.

- Volume I is a general summary of the entire study, including its primary findings, intended for use by decision makers.
- Volume II is the main body of the report intended for use by specialists who will evaluate and implement the plan.
- Appendix I consists of three parts: (1) MSAP airports and airport classification; (2) table of unit costs; and (3) individual airport summaries including detailed aviation activity forecasts, summary and detailed cost estimates for required development by periods, along with an aerial photograph or sketch for each airport.
- Appendix II consists of: (1) history and forecasts of dependent and independent variables and the forecasting equation for each air carrier airport; (2) civil aircraft types by user category classified by seating capacity and operational group; (3) individual airport financial feasibility analysis grouped by county.
- Appendix III is a computerized data bank of Montana airports containing the physical and operational characteristics for the base year 1972, which is presented separately.

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INTRODUCTION

I. INTRODUCTION

This volume summarizes the results of a comprehensive study to produce a definitive plan for the development of an efficient air transportation network or system of airports in the State of Montana. Detailed backup assumptions, statistical data, derivations, and methodologies used in formulating the Montana State Airport System Plan (MSASP) are contained in four additional volumes consisting of a technical supplement and three appendices. The Summary Report includes the primary findings of the entire study and is intended for cognizant State, regional, and Federal legislators and administrators as well as for non-government airport executives involved in the planning, construction, and operation of facilities to transport people and goods by air. The technical supplement and its appendices provide the necessary detail for use by specialists who may be called upon to evaluate and implement the Plan.

A. PURPOSES AND OBJECTIVES

The basic purpose of the MSASP is to delineate the aviation facilities that will be required to meet the short-, intermediate-, and long-term air transportation needs of the State of Montana. A corollary purpose of the Plan is to prescribe a unified means of coordinating, directing, and integrating many diverse airport development projects in such manner that the overall State airport system will yield maximum benefits to all residents of the State.

Major objectives of the MSASP are:

1. To provide for the orderly and timely development of a system of airports within the State during the next two decades (1973-1992).

2. To provide a basis for coordinating State airport plans and the planning by metropolitan and regional agencies with respect to ground transportation, land use, economic development, and resource utilization.

3. To bring to the general public, government agencies, educational institutions, and industrial establishments at local and national levels an awareness of State airport facility requirements and the need for a systematic approach to airport planning and development.

4. To provide guidelines for use at the local level to accomplish all phases of planning (preliminary, master, and detail) and in estimating development costs.

5. To make possible long-range coordination of air-navigation facilities, airspace use, airport development, and air traffic control procedures in four phases over the time sequence: 1977, 1982, 1987, 1992.

6. To identify general locations of all airports, specified as to type and size, that will bring air transportation means within reasonable reach of all communities in Montana.

7. To provide for orderly allocation of land for airport facilities.

8. To minimize airport-related environmental problems.

B. OVERVIEW OF EXISTING RESOURCES

Montana, the fourth largest state in geographical area, with a population of only 694,409 in 1970, has 148 public-use airports. Fifteen of these airports serve scheduled air carriers, and the remainder serve only general aviation. It was concluded from initial analysis of the 148 airports that only 118 of these were worthy of further consideration as possible candidates under the MSASP. For these 118 airports, pertinent data were compiled with respect to airport location, facilities and services, ownership—whether by a local government, private, or Federal—runways, operations, registered and actually based aircraft, and the physical characteristics of the airport and its environs. An in-depth study of the data has shown that 106 of the existing airports could adequately be developed to fulfill the objectives of the MSASP for a twenty-year period.

C. ACKNOWLEDGMENTS

A joint Study Team from the firms of Knoerle, Bender, Stone and Associates and Airways Engineering Corporation coordinated its efforts on this study and Plan to a large extent with the ongoing planning of the Montana State Aeronautics Division. Other primary Montana State agencies that contributed to the study were (1) The Division of Planning and Economic Development of the Department of Intergovernmental Relations, and (2) The Montana State Highway Commission. To a lesser extent, the Study Team acquired information from the Montana Fish and Game Commission and the Montana State Board of Equalization.

Other organizations in Montana which were of benefit to the Study Team included: (1) Montana Airport Managers' Association; (2) Montana Property Taxpayers' Association; and (3) The Bureau of Business and Economic Research, University of Montana.

Federal agencies which contributed to the Study Group were: (1) The Federal Aviation Administration, including personnel from district and regional offices, and control tower and air-route traffic control personnel throughout the State, and (2) U.S. Forest Service.

Members of the Study Team profited from discussions with airport managers, fixed-base operators, pilots, and maintenance personnel at Montana airports which were physically inspected by the members; these included every airport in Montana, except five small airports which had no based aircraft.

The Study Team is grateful for the valuable information and guidance received from all of the organizations and individuals contacted.

ANALYSIS OF THE EXISTING SYSTEM

II. ANALYSIS OF THE EXISTING SYSTEM

This section summarizes the analysis made of Montana's existing airport system to provide a basis for determining State airport development needs. Elements treated in this analysis are: aircraft characteristics, present airspace utilization, locations and characteristics of airports, physical environment and land use, other modes of transportation, and a comparison of future demand for air transportation to the capacity of the existing airport system.

A. AIRCRAFT CHARACTERISTICS

The aircraft expected to be used under the MSASP are those which are common to air carrier, general aviation, and military service throughout the country. Special provision in the Plan to accommodate unusual aircraft types is not considered necessary. It is anticipated that STOL (short takeoff and landing) operations may increase. However, no special requirements for servicing this type of operation have been identified.

B. PRESENT AIRSPACE UTILIZATION

It appears that each of the airports in Montana is presently operating well below its capacity with respect to the utilization of airspace on airway routes.

Relatively few recorded flight plans for general-aviation aircraft were obtained in response to a questionnaire mailed during September 1972 to all airports in Montana. Indications are, however, that general-aviation traffic is not sufficient to justify augmentation of existing civil airways in the State.

Better data on the general-aviation flight plans involving the busier airway routes to Montana airport destinations were obtained from *Air Traffic Patterns for IFR and VFR Aviation,* Federal Aviation Administration, dated June 1972. Nearly three-fourths of the flight plans filed during 1971 at Montana flight service stations or combined station towers for these busy routes were for Visual Flight Rules, and the remainder were for Instrument Flight Rules. Virtually all of the general-aviation Visual Flight Rules traffic is concentrated at altitudes below 10,000 feet.

C. AIRPORT LOCATIONS AND CHARACTERISTICS

Each airport considered in the study is described in relation to its geography in Appendix I. Actual corrected runway lengths, surface types, lighting, and other relevant airport characteristics are represented in Figure II-6.

Montana, with a total surface area of approximately 147,000 square miles, is served by 148 public-use airports. For the 118 public-use airports selected for consideration in the MSASP, as described in the Introduction, the average area served by each of these airports is 1,246 square miles, which is equivalent to an area of approximately a 20-mile radius from each airport. If the 118 airports were uniformly distributed in the State, each airport would serve an area having a radius of approximately 20 miles. By comparison, the Kentucky State Airport System Plan considered 57 public-use airports in a total state area of approximately 40,400 square miles, or an average service area for each airport of 709 square miles, corresponding to approximately a 15-mile radius from each airport. It is evident from these figures and from the fact that Montana has only 6 per cent of Kentucky's population density that the 118 public-use airports considered for the MSASP would be more than adequate.

The average air-carrier airport in Montana serves persons situated within a 100-mile radius from the airport—a distance which can be covered by car in a time considered to be appreciably greater than desirable. In view of the State's sparse population, however, comparatively few persons would be affected; hence, it cannot be implied that the number of air-carrier airports in the State is inadequate.

D. PHYSICAL ENVIRONMENT AND LAND USE

Montana's airports, with a large number of general-aviation compared to air-carrier airports, are principally located in thinly populated areas. Thus takeoff and landing operations at these airports pose relatively few environmental problems such as noise, air-pollution, and heavy traffic on airport access roads. Air-carrier approach and takeoff operations near the more heavily populated urban areas have engendered very few complaints from local residents. For example, in the vicinity of Helena, the air-traffic patterns over its airport are to the north, away from the central business district and residential areas.

Few airports are close to populated areas in Montana, and it is still possible, because of the large amounts of open land, to develop communities that would be unaffected by airport-related environmental problems.

Photographs taken in 1935 show that the area surrounding Los Angeles Airport was relatively free of homes and business developments. Since that time, the airport's environs have become entirely residential, and the airport pays indemnities to the people to compensate them for noise distress. To prevent these undesirable consequences in Montana,

it is urged that the airport owners should spare no effort to purchase land for airport easements and also to encourage other governmental units to improve land-use zoning around the airports to preclude future adverse effects on environs.

The state-of-the-art of land-use planning in Montana is in its infancy. Although at the present time Montana is not plagued with airport-related environmental problems, it is imperative to seek vigorous measures in order to safeguard Montana's airports and their environs against the impacts from intrusions of surrounding land uses, noise factors, and other potential environmental problems.

E. OTHER TRANSPORTATION SYSTEMS

Montana has many topographical and other features (extensive forests, national parks, mountains, grazing lands, Indian lands) which serve as impediments to ground transportation. Moreover, the Canadian border forms a complicating factor that tends to restrict the free flow of commerce by ground transportation means.

It is expected that Montana's highway system will be increased by approximately 1,000 miles[1]. The addition is to be comprised primarily of interstate highway and minor collectors; arterials will lose mileage. This will amount to an overall increase of slightly more than 1 per cent of the present highway mileage—actually an insignificant increase. The decrease in mileage of local road, which is the lowest roadway class, will be reflected in improvements to existing routes. It is anticipated that many of the presently unpaved roads will be paved by 1992, but the present configuration of the State highway system will remain essentially unchanged by that year.

It is likely, also, that air transportation will become increasingly more important in the ensuing years. This mode of transportation is independent of terrain conditions and affords several advantages—including speed, flexibility, allowing travel over natural stages and man-made barriers, and reliability over other means of travel.

F. DEMAND VERSUS CAPACITY

A detailed comparison of the demand for air transportation to the air-traffic capacity of individual airports (demand/capacity) under consideration for the MSASP is presented in Appendix I. A brief summary of the findings is given below.

Two basic FAA advisory circulars were used for the demand/capacity analysis: 150/5060-1A, *Airport Capacity Criteria Used in Preparing the National Airport Plan,* and 150/5060-3, *Airport Capacity Used in Long-Range Planning.* Both demand and capacity are expressed in terms of the annual numbers of operations, an operation being a takeoff or a landing. Capacity is not an absolute figure, since it can be changed by spreading traffic peaks or keeping aircraft waiting for shorter or longer periods to take off or to land. The commonly accepted bases for measuring capacity (designated "Practical Annual Capacity") assumes, for air-carrier operations, an average departure delay of no more than four minutes during the normal peak two-hour period of the week. Capacity ratings for runways used by general aviation aircraft are predicated on a two-minute delay.

[1] *Montana Highway Functional Classification and Needs Study,* 1970-1990, by Menasco-McGuinn Associates.

1. *Air-Carrier Airports*

The MSASP assumes that conventional takeoff or landing (CTOL) aircraft will be used for the forecast period of this study. Billings, Bozeman, Great Falls, Helena, Missoula, and Kalispell (international) airports will most likely have capacity deficiencies during the forecast period. At each of these airports, a short parallel runway for general-aviation aircraft should alleviate the problem.

2. *General-Aviation Airports*

It is not foreseen that general-aviation airports will be deficient in runway capacity in the near future. A basic single-runway configuration without a parallel taxiway is usually sufficient. Exit ratings for long-term planning purposes suggested in FAA Advisory Circular 150/5060-3, however, may make it necessary to provide for additional taxiways and exits in order to attain the increased capacity at these airports that would be commensurate with the projected demand.

FORECAST OF AVIATION ACTIVITY

III. FORECAST OF AVIATION ACTIVITY

A. APPROACH

To determine aviation facility requirements, projections of 23 aviation activity categories were made for each of the 118 airports considered in the Montana State Airport System Plan. These categories are presented in Table III-1. The general methodological forecasting procedure is flow-charted in Figure III-1. The first two projections–air-carrier enplaned passengers and general-aviation itinerant operations–served as the basic control forecasts for the derivation of the others.

The primary tool used in the derivation of these two forecasts was multiple-regression analysis–a statistical technique which serves to define mathematical relationships among selected variables. Trends in air carrier enplanements and general-aviation itinerant operations were correlated with trends in various socio-economic indicators, and mathematical equations were derived and used as a basis for the derivation of the forecasts.

Based on one of three interrelated economic theories concerning the generation of air travel demand, a forecasting equation for air-carrier enplanements was derived for each of the fourteen Montana air-carrier airports except Bozeman.

The forecasts for the other parameters, except air cargo volumes, were derived from these basic forecasts. The forecast for air cargo was derived independently according to a regression analysis of historical total data for the State.

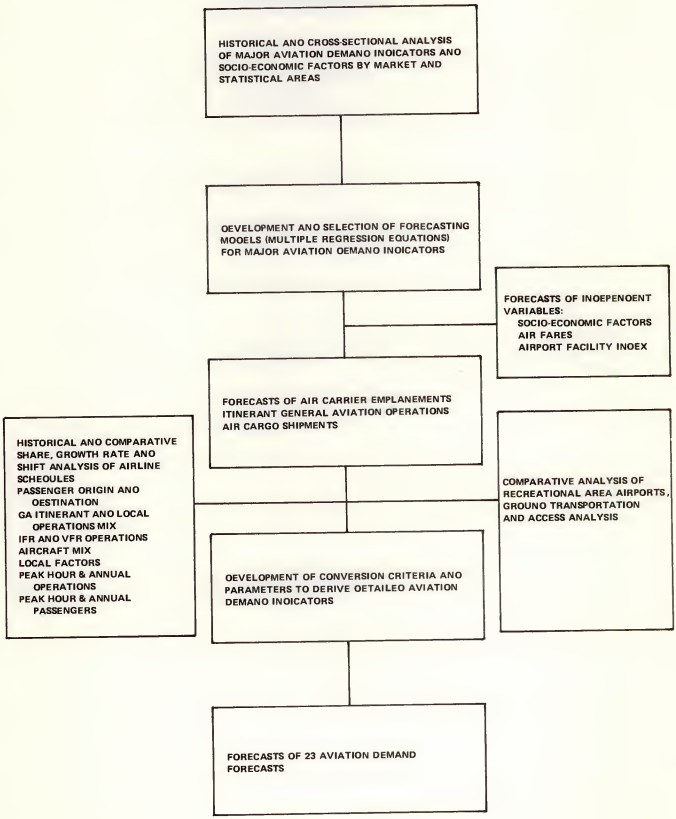
Detailed accounts of the various forecasting procedures are presented in the Technical Supplement. Aviation demand forecasts by planning periods for each airport in the MSASP are contained in Appendix I.

TABLE III-1

MONTANA STATE AIRPORT SYSTEM PLAN
AVIATION ACTIVITY FORECAST CATEGORIES

1. Air carrier enplaned passengers
2. General aviation itinerant operations
3. Air carrier peak-hour passengers
4. Total air carrier annual operations
5. Air carrier peak-hour operations
6. Air carrier average turn-around time
7. Annual air cargo (freight, express, mail)
8. Percentage of Aircraft Type X
9. Percentage of Aircraft Type X-1
10. Percentage of Aircraft Type L
11. Percentage of Aircraft Type M
12. Percentage of Aircraft Type S and T
13. Total general aviation annual operations
14. General aviation peak-hour operations
15. Percentage of general aviation itinerant operations
16. Based aircraft under 12,500 lbs.
17. Based aircraft over 12,500 lbs.
18. Peak-hour IFR general aviation operations
19. Critical aircraft forecast by airport
20. Peak-hour IFR air carrier operations
21. Total air carrier and general aviation peak-hour VFR operations
22. Total air carrier and general aviation peak-hour IFR operations
23. Operational aircraft mix

FIGURE III-1: Forecasting Procedure Flow-Chart



B. SUMMARY OF RESULTS

The following conclusions were reached concerning the future of aviation traffic in Montana:

1. Growth in annual passenger enplanements for Montana is expected to be slightly below national levels. An average annual growth in passenger enplanements of approximately 8.1% per year has been forecasted for the air-carrier airports of Montana. The total annual enplaned passengers are projected to increase from 466,000 in 1970 to more than 2,600,000 in 1992.

2. The annual growth rates indicated will range from 4% at Wolf Point, Sidney, and Glendive to 8% at the larger airports of Billings and Great Falls and 13% at Bozeman. For Kalispell and West Yellowstone, which serve large national recreation areas, annual growth rates of 12% per year have been forecasted.

3. The trends in general aviation indicate a State-wide growth of 3% to 4% per year in total operations, with rates ranging from zero to 5.5% at the larger airports.

In summary, the general trend in air activity for Montana for the next 20 years is seen as relatively stable, with no airports showing rapid growth and with overall growth to be below expected national levels.

FUTURE AIRPORT SYSTEM REQUIREMENTS

IV. FUTURE AIRPORT SYSTEM REQUIREMENTS

A. GENERAL

Data obtained from a comprehensive forecast of aviation activity through 1992 (detailed in Chapter IV of the Technical Supplement) were translated into aviation demand planning parameters and thence into airport facility requirements in two major categories: (1) airside facility requirements, which refer to runways, taxiways, runway exits, lights, NAVAIDS, and other items not within or serving the terminal complex proper; and (2) landside requirements, which pertain to such components of the terminal complex as aprons, loading gates, terminal space, cargo-handling space, maintenance buildings and equipment, emergency and rescue buildings, hangar space, and automobile parking space.

In order to provide a means of gauging requirements for various items in these facility categories, it was necessary to adapt the classification criteria, especially for general-aviation airports, established by the FAA (Advisory Circular 150/5090-2). Table IV-1 shows the classification of all general-aviation airports in Montana over the period 1972 through 1992, in five-year intervals. Classification elements symbolized in the table are as follows:

TABLE IV-1

CLASSIFICATION OF GENERAL AVIATION AIRPORTS IN MONTANA

AIRPORT	CLASSIFICATION									
	1972		1977		1982		1987		1992	
ANACONDA	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
ASHLAND	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
AUGUSTA	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
BABB	F3	MS	F3	MS	F3	MS	F3	BU	F3	BU
BAKER	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
BENCHMARK	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
BIG SANDY	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
BIG TIMBER	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
BOULDER	F3	MS	F3	MS	F3	MS	F3	BU	F3	BU
BRIDGER	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
BROADUS	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
BROWNING	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
CARTER	U		U		U		U		U	
CHESTER	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
CHINOOK	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
CHOTEAU	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
CIRCLE	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
CLINTON	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
COLUMBUS	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
CONDON	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
CONRAD	F3	BU	F3	BU	F+	BU	F3	BU	F3	BU
CULBERTSON	F3	BU	F3	BU	F3	GU	F3	GU	F3	GU
CUT BANK	F3	BU	F3	BU	F3	BU	F3	GU	F3	BT
DEER LODGE	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
DELL	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
DENTON	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
DILLON	F3	BU	F3	BU	F3	BU	F3	GU	F3	BT
DRUMMOND	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
DUTTON	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
EAST POPLAR	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
EKALAKA	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
ENNIS	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
EUREKA	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
FAIRFIELD	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
FAIRVIEW	F3	MS	F3	MS	F3	MS	F3	MS	F3	BU
FORSYTH	F3	BU	F3	GU	F3	GU	F3	GU	F3	GU
FORT BENTON	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
FORTINE	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
FT. SMITH	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
GERALDINE	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
GRASSRANGE	U		U		U		U		U	
HAMILTON	F3	BU	F3	BU	F3	BU	F3	GU	F3	BT
HARDIN	F3	BU	F3	BU	F3	BU	F3	BU	F3	GU
HARLEM	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
HARLOWTON	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
HINSDALE	U		U		U		U		U	
HOT SPRINGS	F3	MS	F3	MS	F3	MS	F3	BU	F3	BU
HYSHAM	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
JACKSON	U		U		U		U		U	
JORDAN	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
KALISPELL (CITY)	F3	BU	F2	BU	F2	BU	F2	BU	F2	BU
LAUREL	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
LAYINA	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
LIBBY	F3	BU	F3	BU	F3	BU	F3	BU	F3	GU
LINCOLN	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
LIVINGSTON	F3	BU	F3	BU	F3	GU	F3	GU	F3	GU
MALTA	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
MEADOW CREEK	U		U		F3	MS	F3	MS	F3	MS
MEDICINE LAKE	U		U		F3	MS	F3	MS	F3	MS
MORGAN	U		U		F3	MS	F3	MS	F3	MS

TABLE IV-1 (Continued

AIRPORT AIRPORT	CLASSIFICATION									
	1972		1977		1982		1987		1992	
OPHEIM	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
PEERLESS	U		U		U		U		U	
PHILIPSBURG	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
PLAINS	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
PLENTYWOOD	F3	BU	F3	BU	F3	BU	F3	BU	F3	GU
POLEBRIDGE (SONDERSON)	U		U		U		U		U	
POLSON	F3	BU	F3	GU	F3	GU	F3	GU	F3	GU
POPLAR	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
REO LOOGE	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
RICHEY	U		U		U		U		U	
ROMAN	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
ROUNOUP	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
RYEGATE	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
ST. IGNATIUS	F3	MS	F3	MS	F3	MS	F3	BU	F3	BU
SCHAFER	U		U		U		F3	MS	F3	MS
SCOBEY	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
SEELY LAKE	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
SHELBY	F3	BU	F3	BU	F3	GU	F3	GU	F3	GU
SPOTTED BEAR	U		F3	MS	F3	MS	F3	MS	F3	MS
STANFORD	F3	MS	F3	MS	F3	MS	F3	MS	F3	BU
STEVENSVILLE	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
SUNBURST	U		U		U		U		U	
SUPERIOR	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
STREETGRASS	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
TERRY	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
THOMPSON FALLS	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
THREE FORKS	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
TIBER OAM	U		U		F3	MS	F3	MS	F3	MS
TOWNSEND	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
TOWNSEND CANYON	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
TROY	F3	MS	F3	MS	F3	MS	F3	BU	F3	BU
TURNER	F3	MS	F3	MS	F3	MS	F3	BU	F3	BU
TWIN BRIOGES	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
VALIER	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
WHITEFISH	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
WHITE SULPHUR SPRING	F3	BU	F3	BU	F3	BU	F3	BU	F3	BU
WILSALL	U		U		U		U		U	
WINIFRED	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS
WISOOM	F3	MS	F3	MS	F3	MS	F3	BU	F3	BU
WOLF CREEK	F3	MS	F3	MS	F3	MS	F3	MS	F3	MS

F3 – Feeder System
(Low Aeronautical Density)

BU – Basic Utility

GU – General Utility

BT – Basic Transport

MS – Montana State System Only

U – Local Interest Only

For the above classification elements, the symbol MS (Montana State System Only) denotes those airports which would qualify for the MSASP but not for the National Airport System Plan (NASP). The symbol U means that an airport does not qualify for either the MSASP or the NASP.

The concept of the aviation demand factor (ADF) mentioned above was formulated by the FAA for use as a criterion in determining the eligibility of an airport to enter the NASP. Quantitative values of these factors are derived by adding the following points for each airport considered: (a) 10 points for each engine on an aircraft; (b) 100 points per 2000 annual itinerant operations; and (c) 5 to 100 points based on other criteria contained in FAA Order 5090.3, Appendix 7. For certain airports with special qualifications, 100 ADF points were assigned so that the airports can qualify for inclusion in the NASP. According to the FAA criteria, an airport must have an ADF of at least 100 points to be eligible for entry into the NASP. Table IV-2 lists the forecast ADF values for each general-aviation airport in Montana over the period 1977 through 1992, in five-year intervals. The check marks indicate the year in which an airport in MSASP would be eligible for entry into the NASP. (Only general-aviation airports were considered in this Summary, as all air-carrier airports are, by definition, included under the NASP.)

In addition to the MSASP requirements for airside and landside facilities, this chapter summarizes airspace (air-route) and navigational requirements and the requirements for possible alternative (additional) airports in the State.

B. ALTERNATIVE AIRPORT LOCATIONS

Table IV-3 lists the existing 106 airports included under the MSASP. The airports are classified by ownership (Federal, State, or municipality–cities, counties, and authorities). The table also indicates the 15 air-carrier airports, the remainder (91) being general-aviation airports.

With respect to airport location, the existing air-carrier system is nearly optimum for serving present and future demand, although there are facility conditions which should be corrected to satisfy FAA standards. Butte airport may require relocation to eliminate congestion and to improve safety.

There is no need to develop a regional airport that would combine facilities to serve one or more cities. According to FAA Advisory Circular 150/5090-1, a regional airport would be recommended when the use of a single airport serving communities within a radius of 50 miles would result in a savings to both the Federal government and the communities involved. The logic of a related concept for scheduled-air-carrier airports can be illustrated with reference to Table IV-4, which lists all Montana towns which have populations exceeding 2,000 and which are situated more than 50 miles from the

TABLE IV-2
AVIATION DEMAND FACTORS
TO QUALIFY MONTANA GENERAL AVIATION AIRPORTS
IN THE NATIONAL AIRPORT SYSTEM PLAN

AIRPORT	AERONAUTICS DEMAND FACTORS				DATE OF ENTRY IN NASP			
	1977	1982	1987	1992	1977	1982	1987	1992
ANACONOA	150	185	180	200	√	√	√	√
ASHLAND	125	145	165	185	√	√	√	√
BABB	68	88	128	139			√	√
BAKER	235	285	295	330	√	√	√	√
BENCHMARK	100	100	100	100	√	√	√	√
BIG TIMBER	215	237	255	280	√	√	√	√
BOULDER	88	88	105	108			√	√
BROADUS	110	125	140	155	√	√	√	√
BROWNING	134	145	169	192	√	√	√	√
CHESTER	180	180	196	220	√	√	√	√
CHINOOK	270	295	318	340	√	√	√	√
CHOTEAU	140	145	165	175	√	√	√	√
CIRCLE	150	200	250	300	√	√	√	√
COLUMBUS	150	180	200	225	√	√	√	√
CONRAD	360	400	450	500	√	√	√	√
CULBERTSON	180	200	250	300	√	√	√	√
CUT BANK	515	570	625	880	√	√	√	√
DEER LODGE	105	152	185	188	√	√	√	√
DILLON	310	555	635	715	√	√	√	√
DRUMMOND	100	103	119	135	√	√	√	√
EKALAKA	100	125	150	180	√	√	√	√
ENNIS	200	320	350	400	√	√	√	√
EUREKA	185	205	220	240	√	√	√	√
FAIRVIEW	60	85	88	113				√
FORSYTH	205	230	255	280	√	√	√	√
FORT BENTON	215	225	245	255	√	√	√	√
GERALDINE	135	155	170	185	√	√	√	√
HAMILTON	655	753	845	990	√	√	√	√
HARDIN	285	305	325	345	√	√	√	√
HARLEM	180	195	215	235	√	√	√	√
HARLOWTON	100	100	120	130	√	√	√	√

AIRPORT	AERONAUTICS DEMAND FACTORS				DATE OF ENTRY IN NASP			
	1977	1982	1987	1992	1977	1982	1987	1992
HOT SPRINGS	85	80	100	120			√	√
JORDAN	120	145	185	225	√	√	√	√
KALISPELL (CITY)	850	945	1070	1205	•	•	•	•
LAUREL	250	320	415	520	√	√	√	√
LIBBY	375	415	480	515	√	√	√	√
LINCOLN	100	110	130	152	√	√	√	√
LIVINGSTON	360	400	450	500	√	√	√	√
MALTA	140	230	278	325	√	√	√	√
PHILIPSBURG	240	355	370	375	√	√	√	√
PLAINS	120	140	160	180	√	√	√	√
PLENTYWOOD	270	385	400	440	√	√	√	√
POLSON	290	350	500	705	√	√	√	√
POPLAR	105	121	140	155	√	√	√	√
RED LODGE	210	235	255	280	√	√	√	√
ROUNDUP	180	205	230	280	√	√	√	√
ST. IGNATIUS	84	80	100	112			√	√
SCOBEY	100	150	200	255	√	√	√	√
SHELBY	340	375	415	485	√	√	√	√
STANFORD	60	75	90	105				√
STEVENSVILLE	100	130	166	204	√	√	√	√
SUPERIOR	100	100	120	140	√	√	√	√
TERRY	100	100	110	120	√	√	√	√
THREE FORKS	115	120	135	140	√	√	√	√
TOWNSEND	100	115	135	155	√	√	√	√
TROY	72	78	150	180			√	√
TURNER	75	80	100	100			√	√
TWIN BRIDGES	150	155	160	185	√	√	√	√
VALIER	115	135	155	175	√	√	√	√
WHITE SULPHUR SPRING	150	160	178	200	√	√	√	√
WISDOM	75	90	154	154			√	√

*NOT IN NASP. (LESS THAN 20 GROUND MILES TO GLACIER PARK INTERNATIONAL AIRPORT)

Note: check marks (√) show year in which an airport would be qualified to enter NASP.

TABLE IV-3

MONTANA STATE AIRPORT SYSTEM PLAN
AIRPORTS BY OWNERSHIP CLASSIFICATION

FEDERAL			
Benchmark	Fort Smith	Schaffer	Troy
Cordon	Meadow Creek	Spotted Bear	
STATE			
West Yellowstone*	Clinton	Sweet Grass	Townsend C.F.
Babb	Dell	Tiber Dam	Wolf Creek
Browning	Lincoln		
MUNICIPALITIES			
Billings*	Glendive*	Kalispell G.P.I.*	Sidney*
Bozeman*	Great Falls*	Lewistown*	Wolf Point*
Butte*	Havre*	Miles City*	
Glasgow*	Helena*	Missoula*	
Anaconda	Dillon	Jordan	St. Ignatius
Ashland	Drummond	Kalispell City	Scobey
Augusta	Dutton	Laurel	Seely Lake
Baker	East Poplar	Lavina	Shelby
Big Sandy	Ekalaka	Libby	Standford
Big Timber	Ennis	Livingston	Stevensville
Boulder	Eureka	Malta	Superior
Bridger	Fairfield	Medicine Lake	Terry
Broadus	Fairview	Morgan	Thompson Falls
Chester	Forsyth	Opheim	Three Forks
Chinook	Fort Benton	Phillipsburg	Townsend
Choteau	Fortine	Plains	Turner
Circle	Geraldine	Plentywood	Twin Bridge
Columbus	Hamilton	Polson	Valier
Conrad	Hardin	Poplar	White Sulphur Spring
Culbertson	Harlem	Red Lodge	Whitefish
Cut Bank	Harlowton	Ronan	Winifred
Deer Lodge	Hot Springs	Roundup	Wisdom
Denton	Hysham	Ryegate	

*Air-Carrier Airport

TABLE IV-4

ALL MONTANA COMMUNITIES OF 1970 POPULATION OVER 2,000
WITH DISTANCE TO NEAREST AIR CARRIER AIRPORT OVER 50 MILES

Community	Population	Air Carrier Airport	Distance	
			Highway Miles	Approximate Travel Time (hrs.)
Baker	2,554	Miles City	81	2
Conrad	2,770	Great Falls	58	1-½
Cut Bank	4,004	Great Falls	90	2
Dillon	4,548	Butte	60	1-½
Libby	3,286	Kalispell	90	2
Malta	2,195	Glasgow	71	1-¾
Plentywood	2,381	Williston, N.D.	84	2
Roundup	2,116	Billings	53	1-½
Shelby	3,111	Great Falls	67	1-¾

nearest air-carrier airport. Travel time by highway between any of these towns and the airport is not greater than two hours. In view of the small population and the limited economic growth potential of the communities, it would be economically impractical to support the development of additional air-carrier airports in the vicinity.

The development of an air-carrier airport in the tri-city region encompassing Cut Bank, Conrad, and Shelby is not recommended for the following reasons:

1. It is unlikely that sufficient demand for scheduled air-carrier service could be sustained in view of the adequate service already provided by the Great Falls International Airport, which is only 67 miles from Conrad, 83 miles from Shelby, and 90 miles from Cut Bank.

2. With the expected completion of Interstate Highway 15, travel time between each of these towns and the Great Falls airport will be reduced by approximately half an hour.

Finally, since the population and economic growth rates of major Montana cities are not expected to increase drastically during the forecast period of this study, requirements for alternative new major international airports or major hub airports are not anticipated.

In the remainder of this chapter, MSASP requirements for expansion of existing airports, their physical facilities, and air-route navigation aids are summarized.

C. AIRSPACE REQUIREMENTS

1. *Enroute NAVAIDS*

The main air navigation problem in Montana stems from the high-altitude terrain in the western part of the State. Federal expenditure on enroute navigational aids (NAVAIDS) for Montana has been limited in the past by the relatively small population density of the State and consequent low volume of air traffic.

Taking the present design of the air-route structure into consideration, a comparison was made of minimum obstacle clearance altitude (MOCA) with authorized minimum enroute altitude (MEA) along a number of route segments. This comparison indicates instances in which an additional IFR cardinal altitude could be realized by adding another facility to provide very high frequency omnidirectional range (VOR) signal coverage at the MOCA.

For example, in an airway segment between Glasgow and Williston, MOCA is 4,600 feet and MEA is 6,000 feet. In this segment, a 5,000-foot cardinal altitude could be gained by adding a VOR facility near Wolf Point; by this means, an air-carrier airport could be provided with the VOR instrument approach capability it now lacks. The dual benefit that would result from this additional VOR facility should justify its inclusion in the FAA Facilities and Equipment (F&E) Program. Where only one altitude is adequate on an airway not operating near capacity, the cost of the additional VOR does not appear to be justified.

In another airway segment, between Miles City and Dupree, MOCA is 6,000 feet and MEA is 9,500 feet. If a new VOR facility were located at the midway point of the segment in order to provide satisfactory signal coverage at MOCA, it would add cardinal altitudes of

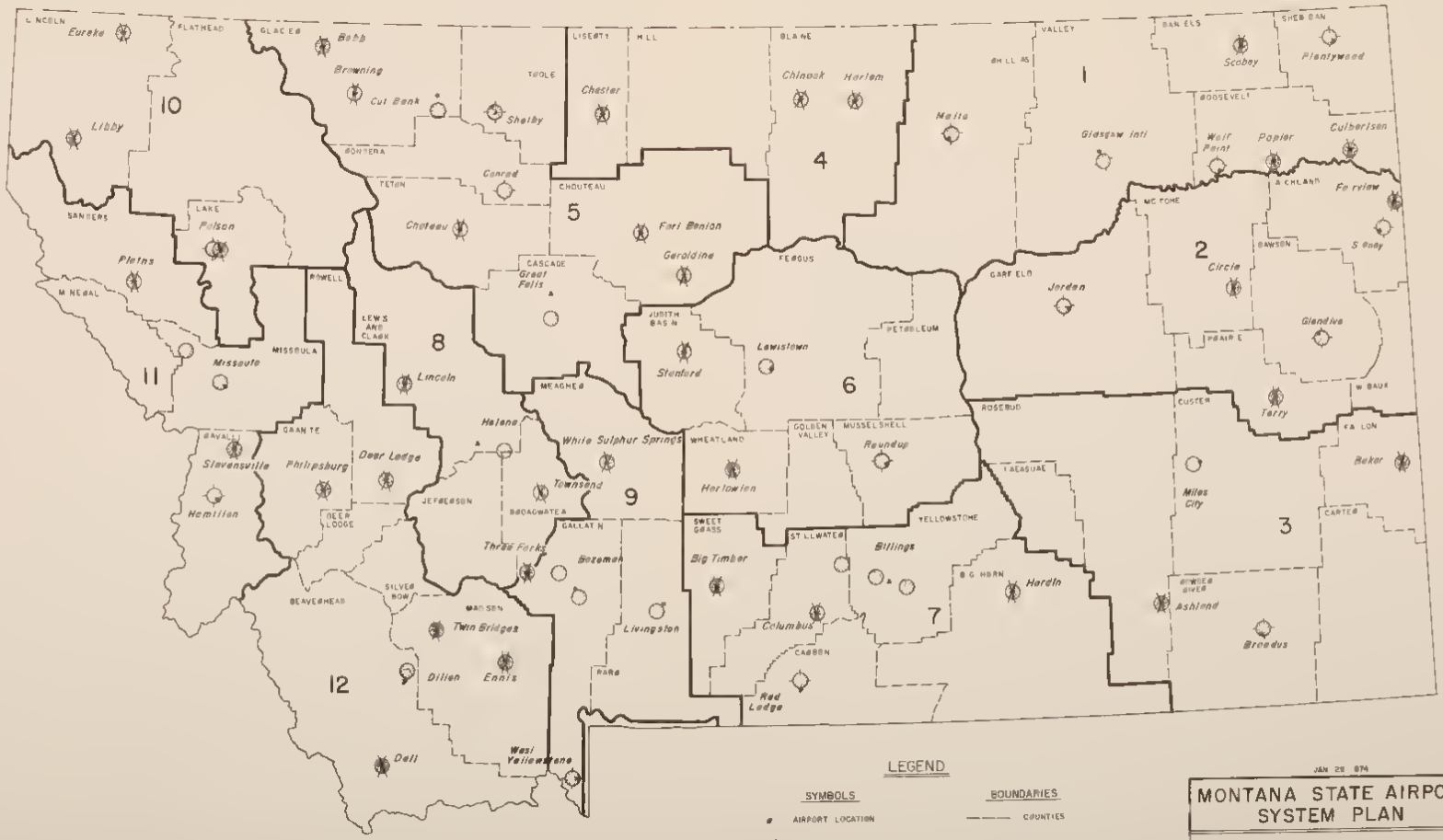

LINCOLN
FLATHEAD
GLACIER
TOOLE
LIBERTY
HILL
BLAINE
VALLEY
SHERIDAN
Eureka
Bob's
Browning
Cut Bank
Shelby
Chester
Chinook
Harlem
Malta
Scobey
Plentywood
Libby
10
4
1
ROOSEVELT
Glasgow Intl
Wolf Point
Poplar
Culbertson
MONTANA
Conrad
TETON
CHOUTEAU
5
Fort Benton
Geraldine
McCONE
Fairview
SANDERS
LAKE
Polson
Choteau
Plains
CASCADE
Great Falls
FERGUS
2
Circle
DAWSON
S Body
MINERAL
POWELL
LEWIS AND CLARK
8
JUDITH BASIN
Stanford
Lewistown
PETROLEUM
GARFIELD
Jordan
Glendive
PRAIRIE
Missoula
MISSOULA
11
Lincoln
MEAGHER
6
ROSEBUD
CUSTER
Terry
W BAUX
GRANITE
Helena
White Sulphur Springs
GOLDEN VALLEY
MUSSELSHELL
Roundup
WHEATLAND
Harlowton
TREASURE
Baker
RAVALLI
Stevensville
Philipsburg
Deer Lodge
Townsend
9
Miles City
3
CARTER
Hamilton
JEFFERSON
BROADWATER
GALLATIN
SWEET GRASS
YELLOWSTONE
Three Forks
Bozeman
Big Timber
ST LLWATER
Billings
BIG HORN
Hardin
Ashland
POWDER RIVER
BEAVERHEAD
SILVER BOW
MADISON
Twin Bridges
Livingston
Columbus
CARBON
Broadus
12
Dillon
Ennis
RAVALLI
Red Lodge
Deli
West Yellowstone
LEGEND
SYMBOLS
AIRPORT LOCATION
OUTAGE NON DIRECTIONAL BEACON
EXISTING FEDERAL NON DIRECTIONAL BEACON
EXISTING NON FEDERAL NON DIRECTIONAL BEACON
BOUNDARIES
COUNTIES
PLANNING DISTRICTS
STATE
CANADIAN / US
JAN 28 '74
MONTANA STATE AIRPORT SYSTEM PLAN
EXISTING AND RECOMMENDED FUTURE NON-DIRECTIONAL BEACONS
SCALE
0
80
40 MILES

FIGURE IV-1

7,000 feet and 8,000 feet. Although the traffic demand forecast does not support it, the cost of the additional facility appears to be justified as a potential for increased service and safety. As an element of the air-route structure, the additional VOR facility would come under the F&E program of the FAA.

For an airway segment between the Kalispell VOR facility and Gates Park intersection (V536), MOCA is 10,900 feet and MEA is 14,000 feet. If this VOR facility were re-located to a point just southwest of the Glacier Park International Airport, the shadowing effect of the mountain range to the east would be reduced. By this move, gains of 12,000 feet and 13,000 feet in cardinal altitude could be expected. Furthermore, as a result of the suggested relocation of the VOR site, a new airway segment could be established to provide a shorter route between Cut Bank and Kalispell. The new airway segment could be based on the 220° radial of the Cut Bank VORTAC (VOR co-located with tactical air navigation) facility intersecting the V536 airway segment approximately 30 miles east of the suggested new VOR site. Taking into consideration the highest terrain of approximately 8,400 feet, it should be possible to establish a MEA of 11,000 feet on the new airway segment. For the short term, however, traffic density on the existing airways does justify relocation of the Kalispell VOR site. By midpoint of the forecast period (1983), a re-evaluation should be made to determine whether the suggested new airway segment would be justified.

2. *Terminal NAVAIDS*

An airport-by-airport breakdown of terminal NAVAID requirements is presented in Appendix I.

For air-carrier airports, the policy with respect to terminal navigation aids is to recommend the use of conventional instrument landing systems (ILS) or microwave landing systems (MLS) with medium-intensity approach light system, and with runway alignment indicator lights (MALSR) where justified by FAA criteria set forth in APS-1. The minimum requirement is the use of a VOR with a visual approach slope indicator (VASI) facility for the straight-in instrument-approach runway. Facilities should be Federally funded where justified by the FAA criteria. Where not justified for full Federal funding, the facilities should be funded under the Airport Development Assistance Plan (ADAP) program.

For general-aviation airports the policy with respect to terminal NAVAIDS is to use ILS or MLS with MALSR, or VOR with VASI, wherever justified by FAA criteria. The minimum requirement is for a VOR or NDB (non-directional radio beacon) with REIL (runway end identification lights) for those locations where IFR demand is predicted. A number of NDB facilities for airports which have a low volume of predicted IFR activity are identified in Appendix 1. Where possible, such facilities should be aligned with the longest runway in order to provide an instrument approach capability down to straight-in approach minima. The requirements for these NDB's are stated in the belief that their installation will promote IFR activity and will greatly enhance the safety of VFR flying both in the vicinity of the airports and throughout the State system. Existing and recommended NDB's are designated in Figure IV-1.

D. AIRSIDE REQUIREMENTS

1. *Overall Factors*

A tabulation of airside (as well as landside) facility requirements for development items at indicated airports is included in Appendix I

With regard to airside facilities at airports, there are several determinants of the requirements for improving the physical characteristics of each airport. Runway length and strength requirements vary, depending upon the demands of the using aircraft. The addition of parallel runways and taxiways depends upon the forecast annual and peak-hour operations; terminal NAVAID requirements depend upon forecast IFR and VFR annual and peak-hour operations. The standards applied are consistent with those contained in current FAA Advisory Circulars. National standards for general-aviation, basic transport (BT) airports are specified in FAA AC 150/5300-6, and standards for all other types of airports are given in FAA AC 150/5300-4A. The same general-aviation airport standards, except for lighting, are also applied to airports which would qualify for the MSASP but not for the NASP. Standards for air-carrier airports are contained in FAA AC 150/5330-2A.

High elevations or high temperatures increase runway length requirements. As the elevations of Montana's airports average 3,400 feet and the mean maximum temperature is about 84°, a typical Montana airport requires about 1.4 times the runway length of an airport at mean sea level and standard temperature.

Runway lengths for air-carrier airports were calculated according to criteria contained in FAA AC 150/5325-4. A corrected sea-level, standard-temperature runway length of 2,000 feet was established as the minimum for the general-aviation airports. As a result of this standard, most of the runways at general-aviation airports will need lengthening. Where airports are included in the NASP under either the Basic Utility or the General Utility classification, standards for runway length were taken from FAA AC 150/5300-4A. Appropriate FAA Advisory Circulars were used for determining the standard lengths of runways at all other classes of airports.

Many Montana general-aviation airports are unpaved, and some even lack runway lights. It was thus necessary to select some parameter or measure of activity as a criterion for determining runway paving and lighting standards at these airports. The Aviation Demand Factor concept (see Section IV-A of this Summary) developed by FAA for the NASP and determined by the number of annual itinerant operations, by the number of based aircraft, and by other special characteristics, provides a good criterion for establishing standards for improvement of these undeveloped runways.

2. *Air-Carrier Airports*

The *Butte* and *Missoula* airports are those in most critical need of development. Both airports have restrictive terrain located within their missed-approach paths, which necessitate very high IFR minima. It is recommended in the Master Plan of the *Butte Site Feasibility Study* that a new airport site for relocation of the Butte Airport be selected at the Stauffer Chemical site. The authors of this MSASP Summary are in agreement with that recommendation. It is estimated that an airport at this site to meet demands to 1992 could be built for about $7,000,000. Another $1,850,000 should be added for terminal developments to allow for future growth. At Missoula, special instrument procedures can obviate the need for a new airport. However, to achieve the minimum horizontal

obstruction/building clearances on the ground, some rearrangement of facilities will be necessary. Also, because of expected growth in peak-hour demand, it is recommended that a parallel runway be built at Missoula in 1982, ten years earlier than is shown in the Missoula Master Plan.

For the *Bozeman* airport, slightly lighter traffic is forecast than is shown in the Airport Master Plan. The developments recommended in that Plan are endorsed in Appendix I, but are recommended to be effected two years later. These developments include a new terminal complex and other buildings to be completed within five years and a parallel general-aviation runway and parallel taxiways to be completed before 1992.

The *Billings* airport will have some airfield congestion and will be lacking in general-aviation area by 1982. Therefore, a general-aviation runway and other developments in the area west of the existing airport are recommended.

Recommendations for other major developments are summarized below.

Helena: Relocate terminal area and build parallel general-aviation runway. Runway 8-26 should have an overlay by 1992.

Great Falls: Runway 16-34 should be extended and strengthened, and a parallel taxiway should be added after 1977. A parallel runway 3-21 should be added in 1982.

Kalispell (G.P.I): Heavy air traffic growth, plus a possible shift of air traffic from the Kalispell City Airport (see list below under General-Aviation Airports), will necessitate construction of a parallel general-aviation runway. Runway strengthening and terminal additions will be required.

Lewistown and Glasgow: Runway reconstruction is required.

Detailed requirements and recommendations are contained in Appendix I.

3. *General-Aviation Airports*

Ninety-one general-aviation airports, including 7 owned and operated by U.S. Government agencies, 9 by the State of Montana, and 75 by municipalities, were considered in the study. The greatest single construction expenditure for the general-aviation airports would be required for runway extension. Detailed future requirements and development costs for each airport are shown in Appendix I, by Federal, State, and local governmental participation, and classified by implementation stage and by detailed facility items. The following list summarizes major developments that would be required for general-aviation airports in Montana.

Ashland: New airport site–1977.

Boulder: New airport site–1987.

Cut Bank: Runway reconstruction.

Ennis: New airport–no delay.

Hamilton: Extensive runway construction.

Kalispell City: Removal of obstructions, plus extensive runway lengthening necessary to accommodate demand, would be extremely difficult at this site. It is recommended that a plan be adopted to shift traffic to Kalispell G.P.I. (see Kalispell G.P.I. under Air-Carrier Airports, above) before 1987.

Polson: New airport site–no delay.

Roundup: Runway reconstruction–miscellaneous.

St. Ignatius: New airport site–1992.

Turner: Main runway paving.

Twin Bridges: Main runway paving.

Valier: Main runway paving.

E. LANDSIDE REQUIREMENTS

In determining landside (terminal area facility) requirements, parametric relationships were established between aviation demand forecasts and airport facility requirement forecasts. The basic criteria or indicators used for this effort appear in *Aviation Demand and Airport Facility Requirement Forecasts for Medium Air Transportation Hubs Through 1980,* U.S. Federal Aviation Administration (1969). These criteria were further refined by the MSASP study team. The following 21 facility requirement items were derived:

1. Terminal Area
2. Cargo Terminal Area
3. Airline Air Carrier (AC) Loading Positions
4. AC Loading & Bypass Apron Areas
5. AC Public Auto Parking Spaces
6. AC Public Auto Parking Areas
7. AC Airport Maintenance Apron Area
8. AC Airport Maintenance Building Area
9. Fire & Emergency Equipment Building Area
10. Number of Fire and Rescue Vehicles
11. General Aviation (GA) Terminal Building Area
12. GA Aircraft Loading Positions
13. GA AC Loading & Bypass Apron Area
14. Itinerant Aircraft Parking Area
15. GA Based Aircraft Tie-Down Area
16. GA Conv. Hangar Building and Apron Area
17. GA "T" Hangar Area
18. GA Public Vehicular Parking Spaces
19. GA Public Vehicular Parking Area
20. GA Airport Maintenance Apron Area
21. GA Airport Maintenance Building Area

F. SUMMARIES OF AIRPORT DEVELOPMENT NEEDS OF THE MSASP

Total facility requirements of all 106 airports in the MSASP (7 under ownership by the Federal government, 10 by the State, and the remaining 89 by "municipalities" in the State–cities, counties, authorities, or private enterprise recommended for transfer to public ownership) can best be represented by capital cost estimates of these required facilities.

Table IV-5 shows the airport development cost summaries of all 106 airports by stages, by Federal and State/local shares and by land and airfield areas. The total cost for overall system development of 106 airports including 7 Federally operated airports for the 1974-1992 period is $79 million, of which $29 million (36%) is anticipated to be landside area development costs, with the balance of $50 million to be costs of facilities in airside areas. The table also shows that the next 4 years–the period 1974 through 1977–will have the highest total development costs (60% of the total), reflecting the fact that existing facilities in Montana will not adequately meet demand without substantial near-term improvements. During this period the total (non-Federal) State and local share of development costs amounts to $21 million and accounts for approximately 61% of the total State and local financing need for the entire twenty-year period.

The cost analysis for the MSASP is detailed in Chapter VI of the Technical Supplement and in Appendix II. A summary of the results of the financial analysis is presented in the following two chapters.

TABLE IV-5

SUMMARY OF TOTAL DEVELOPMENT COSTS OF ALL AIRPORTS IN THE MONTANA STATE AVIATION SYSTEM PLAN, INCLUDING 7 FEDERALLY OWNED AIRPORTS

(in thousands of 1972 dollars)

Development Period	Participation	Landside Area	Airside Area	Total
1974-1977	Federal	5,482	21,286	26,768
	State/Local	12,994	7,610	20,604
	Total	18,476	28,874	47,350
1978-1982	Federal	164	9,947	10,111
	State/Local	3.879	2,592	5,471
	Total	3,043	12,539	15,482
1983-1987	Federal	1,073	6,001	7,074
	State/Local	2,871	1,633	4,504
	Total	3,944	7,634	11,578
1987-1992	Federal	291	1,082	1,373
	State/Local	3,114	306	3,420
	Total	3,405	1,388	4,793
Totals	Federal	7,010	38,316	45,326
	State/Local	21,858	12,141	33,999
	Total	28,868	50,435	79,303

FINANCING BASED ON AIRPORT SYSTEM REQUIREMENTS

V. FINANCING BASED ON AIRPORT SYSTEM REQUIREMENTS

A. INTRODUCTION

This chapter summarizes the results of the analysis made to (1) determine whether existing State and local (municipality) funds under present statutes are adequate to meet development objectives and to conduct functions in operational support of airports under the Montana State Airport System; and (2) establish compliant financing plans. A crucial assumption for the analysis is that any required Federal funding would be made available so long as there are adequate State and local matching funds for development of the Montana Airport System. Details of the analysis are contained in Chapter VI of the Technical Supplement and in Appendix II.

Because of significant differences in public funding and taxation, revenue from State sources is treated separately from revenue derived from local government entities or municipalities. The designation "municipalities" is used for convenience to include cities, counties, authorities, and private enterprise which owns airports recommended for public ownership.

Revenue for supporting State-owned airports and aviation-related administration in the State is derived essentially from aviation-fuel taxes and State-owned-airport operating income. For airports owned by municipalities, airport mill tax levies on real property are the only source of tax revenue. The net operating revenue from individual municipality-owned airports in the State system provides an additional source of income for these airports.

The seven airports which are owned and operated by the Federal government are excluded from the financial analysis. They are: Benchmark, Condon, Fort Smith, Meadow Creek, Schafer, Spotted Bear, and Troy.

The estimation of project costs for the entire State system development plan involved the application of unit costs to the additional facilities required. Future development costs of detailed facility requirements at each airport, through 1992, are itemized in Appendix I.

B. INADEQUACY OF CURRENT FUNDING

1. *State Financing*

Shown in Table V-1 are the forecasts of total costs and revenues to the Montana State Aeronautics Division (MSAD). The revenues comply with existing statutes. Total costs include both the projected development costs of State-owned airports and the net operational and maintenance costs of these airports. Net administrative costs of the MSAD are also included in the total. Total State revenues include revenues from aviation fuel tax, revenues from State-owned airport operations, and other miscellaneous income. Forecasts of aviation-fuel tax and other income are based on the historical trend and on forecasts of aircraft operations by air-carrier airlines and general-aviation airports.

The State funds estimated to be available for each of the periods shown in the table would not provide sufficient financial aid to satisfy the projected airport-related fiscal needs of the municipalities (local governments) in the State, as will be evident from the following paragraphs. Therefore, in order to ensure adequate funding aid to the local-government airports, the State of Montana would have to investigate appropriate means of acquiring increased revenue.

2. *Local-Government Financing*

At present, the municipality-owned airports receive funds (excluding State loans and Federal funds) for operation, maintenance, and development purposes from airport operating revenue (rentals, fees, concessions, etc.) and for property tax levies.

The Municipal Airport Act of the Revised Code of Montana (Article 1-809) states:

> Every municipality is authorized out of any appropriations or other moneys made available for such purposes, to plan, establish, develop, construct, enlarge, improve, maintain, equip, operate, regulate, protect and police airports and air navigation facilities, either within or without the territorial limits of such municipality and within or without the territorial boundaries of this state, including the construction, installation, equipment, maintenance and operation at such airports of buildings and other facilities for the servicing of aircraft or for the comfort and accommodation of air travelers, and the purchase and sale of supplies, goods and commodities as an incident to the operation of its airport properties.

For the purposes stated above, the municipalities are authorized to assess and levy each year a tax not to exceed two mills on the dollar of taxable value of the municipality property (Article 1-804 of the Code cited), but the statute does not allow accumulation of tax receipts (for aviation purposes) for more than one year. Revenues from local property taxes (2-mill maximum) have been used largely for airport maintenance and operation. However, more than two-thirds of the 89 airports owned by municipalities

TABLE V-1

ANALYSIS AND FORECASTS OF STATE FUNDS AVAILABLE FOR STATE AVIATION SYSTEM PROJECTS UNDER EXISTING FUND SOURCES

(in thousands of 1972 constant dollars)

	1974-77	1978-82	1983-87	1988-92	1974-82	1983-92	1974-92
I. Total Costs to the MSAD[a]							
1) State-owned airport development costs	361	27	276	282	388	558	946
2) Net operational costs of State-owned airports	286	416	266	(21)[b]	702	245	947
3) Administrative costs of the MSAD	500	750	875	1,000	1,250	1,875	3,125
Total Costs	1,147	1,193	1,417	1,261	2,340	2,678	5,018
II. Existing Revenue Source							
1) Aviation fuel tax (1¢)	1,572	2,345	2,851	3,476	3,917	6,327	10,244
2) Other income	210	272	287	309	482	596	1,078
Total State Income	1,782	2,617	3,138	3,785	4,399	6,923	11,322
III. State Funds Available	635	1,424	1,721	2,524	2,059	4,245	6,304

[a]MSAD = Montana State Aeronautics Division

[b]Surplus

require more than a two-mill tax to help finance the costs of operating and developing the airports under the MSASP. Because of the no-accumulation clause, it is extremely difficult for any local government to accumulate enough funds for any lump-sum capital investment program (except for airport authorities, which can accumulate funds up to $5,000,000, as allowed by Chapter 2, Section 900, of the Municipal and Regional Airport Act of Montana).

Table V-2 summarizes the portions of the development costs for municipality-owned air-carrier and general-aviation airports that would need to be met from municipality revenue. It is seen, for example, that for the period 1974-1977 the municipalities would need to raise $20,243,000 (assuming that matching funds of $25,290,000 would be furnished by the Federal government). For this period, the State funds that might be available to the municipalities under present legislation would amount to only $635,000 (see Table V-1), which is a negligible percentage of the total local-government revenue needed for the period. For the nine-year period 1974-1982, it can be seen from Table V-3 that the municipalities would need to raise $25,687,000 to meet facility requirements at municipality-owned airports (assuming that the Federal government would provide matching funds of $35,390,000). For this period, funds available from the State would amount to only $2,059,000, again a very small percentage (less than 8%) of the revenue (25,687,000) that the municipalities would need to raise.

Individual airport analyses of financial feasibility (Appendix II) lead to the following conclusion: Funds from local governments and loans from the MSAD (under existing tax legislation and assuming the availability of matching funds from the Federal government) would *not* suffice to meet the costs of airport facility development programs and the operation and maintenance cost of Montana airports under the MSASP for the next 20 years.

In order to avoid the curtailment of airport development within the State during the next 20 years, new sources of revenue, at both the State and local levels, and concomitant legislative changes must be investigated to assure provision for adequate airport facilities under the MSASP.

C. PROVISIONS FOR ADEQUATE FINANCING

1. *State Participation*

In the previous section, it was shown that surplus State funds estimated to be available under present policy would not be sufficient to provide significant financial support to the local governments for airport development programs. In addition, the costs of enlarged MSAD staffing would reduce the estimated surplus State funds to an even lower level. In the following paragraphs, consideration is given to several new sources of funds—other than State general funds—potentially available to the State for participation in municipality airport development programs.

a. Sources of Funds

Two major sources of funds that were identified as reasonable and feasible of attainment or augmentation by the State are:

(1) Aircraft personal property tax

(2) Aviation-fuel tax

TABLE V-2

SUMMARY OF TOTAL LOCAL SHARE OF AIRPORT DEVELOPMENT COSTS FOR AIR CARRIER AND GENERAL AVIATION AIRPORTS OWNED BY MONTANA MUNICIPALITIES

	1974-77	1978-82	1983-87	1988-92	Total
1. COST SUMMARY (in thousands of 1972 constant dollars)					
Air Carrier	16,700	5,105	3,580	2,727	28,112
General Aviation.....	3,543	339	648	411	4,941
Total	20,243	5,444	4,228	3,138	33,053
2. PERCENTAGE DISTRIBUTION BY AIRPORT CATEGORY					
Air Carrier	82.5	93.8	84.7	86.9	85.1
General Aviation.....	17.5	6.2	15.3	13.1	14.9
Total	100.0	100.0	100.0	100.0	100.0

TABLE V-3

TOTAL DEVELOPMENT COSTS OF AIR CARRIER AND GENERAL AVIATION AIRPORTS OPERATED BY MUNICIPALITIES

(in thousands of 1972 dollars)

Development Period	Participation	Landside Area	Airside Area	Total
1974-77	Federal	5,404	19,986	25,290
	Local	12,912	7,331	20,243
	Total	18,316	27,295	45,611
1978-82	Federal	158	9,947	10,105
	Local	2,852	2,592	5,444
	Total	3,010	12,539	15,549
1983-87	Federal	1,056	5,915	6,971
	Local	2,618	1,610	4,228
	Total	3,674	7,525	11,199
1987-92	Federal	269	1,082	1,351
	Local	2,857	281	3,138
	Total	3,126	1,363	4,489
Totals	Federal	6,887	36,930	43,817
	Local	21,239	11,814	33,053
	Total	28,126	48,722	76,848

The aircraft personal property tax is currently levied by the municipalities and is based on the taxable valuation of personal aircraft. Taxable valuations are 20 per cent of assessed property valuations, which in turn are 66-2/3 per cent of wholesale market values. The aircraft property tax has been, on the average, 180 to 200 mills per $1,000 of taxable valuation.

The rationale for transferring aircraft personal property tax revenue from municipalities to the State is that: (1) based on the user-benefit theory of economics, tax on aircraft should be used for promotion and improvement of airports and airways; and (2) by centralizing aircraft registration under administrative control of the State, the latter can both standardize the tax assessment and fully account for all aircraft in Montana, including those aircraft not regularly taken into account by registration (see Inventory and Chapter II of Technical Supplement). Central administration of registering procedures would reduce costly county assessment work and associated administrative costs, with consequent economic benefits; and it would provide accurate statistical enumeration of all aircraft, which would be helpful in forming policy.

To provide additional aviation funds to the State, it is proposed that the current one-cent aviation-fuel tax be increased to two cents. (Aviation-fuel taxes vary widely in other states, from none in 28 states to more than 2 cents in 15 states, and 2 cents or less in 7 states.)

If additional revenue could be obtained by the State from the proposed aircraft personal property tax and increase in aviation-fuel tax, as outlined above, it is estimated that the MSAD would have the following surplus funds available for each of the indicated periods (in millions of 1972 dollars, rounded figures):

(Near Period) 1974-77	(10-Year Period) 1974-82	(20-Year Period) 1974-92
$7.	$17.	$44.

These surplus funds can be apportioned in the form of State aid to the municipalities. The fiscal needs of the municipalities in millions of 1972 dollars (exclusive of the Federal share) for development purposes alone are expected to be as follows:

(Near Period) 1974-77	(10-Year Period) 1974-82	(20-Year Period) 1974-92
$20.	$25.	$33.

To effect the increased State revenue (from the proposed aircraft personal property tax and the one-cent increase in aviation-fuel tax) would require early legislative action. Assuming that the necessary legislation were enacted in time, the State would have at its disposal during the next nine years (1974-1982) for financial aid to the municipalities more than 65 per cent of their share of the costs to finance all of their airport development projects. With the new legislation, the State would be in a sound financial position after 1987 and could provide even greater aid to the municipalities, if necessary. The

estimated surplus State revenues that would result from the new taxation scheme proposed above are compared in Table V-4 to the airport costs to be borne by the State municipalities for time periods from 1974 through 1992.

It should be noted, however, that the precision of the cost estimates (which are based on demand forecasts, as well as on the corresponding facility requirements) is subject to wider margins of error as time spans are extended. Similarly, the precision of the revenue estimates is also subject to wider margins of error over longer time periods. The State plan, therefore, should be reviewed at least every five years.

b. Alternative Plans

From the foregoing considerations, it is concluded that the State could reasonably provide adequate financial aid to the municipalities to enable them to defray the costs of their airport development projects under the MSASP, if one of three plans were followed. Two of the plans, designated Alternative 1 and Alternative 2, are summarized below. The third plan, Alternative 3, is summarized in the next chapter, entitled Implementation Plan. Each of the first two plans, Alternative 1 and Alternative 2, is contingent upon the realization of the following assumptions, which would require legislative action:

(1) Federal aid for the qualified airport facility items will be available if funds are matched by the State and local governments.

(2) Aviation-fuel tax will be raised from one cent to two cents per gallon.

(3) The aircraft personal property tax will be transferred to the State from local governments, and the resulting revenue will be used for grants to local government for airport development.

(4) Local real property tax levies up to a maximum of four mills will be authorized.

(5) The State and local tax revenue will be accumulated for up to 10 years.

(6) The State will participate in funding 50 per cent of all local airport development costs.

Under *Alternative 1,* the State would be required to provide $3,100,000 from the State general fund in addition to the amounts from the other proposed revenues for the period 1974-1977. This will be necessary to assure that the State would fully finance 50 per cent of the local (non-Federal) share of the development costs for all municipality airports during 1974-1977. The revenues generated during the 1978-82 period would be sufficient to pay back $3,100,000 to the State general fund.

Alternative 2 would take effect if the required additional $3,100,000 were not available from the State general fund. Thus, in this event, as for the period 1974-1977, only $7,000,000 would be available from the State, instead of the required $10,000,000 (which is 50 per cent of the total local funds required for that period). With the demand for State aid funds in excess of those available, the State could reduce its participation from 50 per cent to 35 per cent of local matching funds to spread the monies equally to all local projects. This would not solve the problem, however, because local communities would not be able to raise their contributions enough to make up the difference

TABLE V-4

ANALYSIS AND FORECAST OF STATE FUNDS AVAILABLE FOR STATE AVIATION SYSTEM PROJECTS WITH REVENUES FROM ALTERNATE FUND SOURCES

(in thousands of 1972 dollars)

	1974-77	1978-82	1983-87	1988-92	1974-82	1983-92	1974-92
I. Total Costs to the MSAD	1,147	1,193	1,417	1,261	2,340	2,678	5,018
II. Alternate Revenue Sources							
1) Aviation fuel tax (2¢)	3,144	4,690	5,702	6,952	7,834	12,654	20,488
2) Other income	210	272	287	309	482	596	1,078
3) Personal property tax on aircraft	4,780	6,550	7,500	8,450	11,330	15,950	27,280
Total State Income	8,134	11,512	13,489	15,711	19,646	29,200	48,846
III. State Funds Available	6,987	10,319	12,072	14,450	17,306	26,522	43,828
IV. 50% of non-Federal Funds required	10,122	2,722	2,114	1,569	12,844	3,683	16,527
V. Net Difference (III–IV)	– 3,135	7,597	9,958	12,881	4,462	22,839	27,301

with recommended 4-mill property tax revenues. For the initial period 1974-1977, a different approach is necessary under Alternative 2 in order to assure a maximum of airport development.

In this approach, it is recommended that the State establish a priority order of airport development projects and allocate the available funds accordingly. Work on lower-priority projects would be postponed until a later period, when adequate funds would become available. After 1977 it will not be necessary to follow Alternative 2, as the State fund share to the extent of 50 per cent of local airport development costs would become available. These funds will also provide an adequate share to finance the post-poned projects. Priority criteria and funding allocations are described in detail in Chapter VII of the Technical Supplement.

The next section summarizes the funding sources and needs of the municipality-owned airports.

2. *Local-Government Financing*

Municipality airports require funds for operation and maintenance, in addition to funds for development purposes (expansion and improvements). Total financing needs were determined for every local airport in the Montana State Airport System by estimating gross operating revenues, gross operating and maintenance costs, and project development costs. Detailed financial feasibility analyses of individual airports in MSASP are contained in Appendix II.

Most local airports have been operating by deficit spendings, with the result that revenue from the airport property tax (the airport mill levy on property) has been used mainly for airport maintenance and minor expansion programs. The actual imposed mill rate, as required to meet the needs, varies by county, by city, and by year. Past funding procedures indicate that only airport property tax revenue (other than airport operating income) has been used to meet the financial obligations of the city and county airports. Therefore this revenue is assumed to be the source of future funds for the local airports.

In general, the municipalities find it almost impossible to meet financial needs under the restrictions of existing statutes. First, there is a statutory limit on airport real property taxes. The maximum two-mill levy is not sufficient to cover development costs and net operating and maintenance (O&M) costs. Secondly, the municipalities cannot accumulate tax funds for airport development purposes (except for airports run by airport authorities which can accumulate up to $5,000,000) for more than a one-year period. As most of the expansion projects require lump-sum expenditures, it is most unlikely that airports can engage in meaningful development programs.

Under the assumptions that (1) the State will participate in sharing local (non-Federal) development costs equally (50%) with the local airport owners, and (2) airport mill levies on the real property valuations will be increased where necessary and accumulated for at least 10 years, the following conclusions are drawn with respect to the actual mill levies required for financing local-government airport needs (in conjunction with the alternative State funding plans):

a. 63 airports can finance development programs as well as O&M costs with two-mill levies.

b. 15 airports can meet development and O&M costs with three-mill levies.

c. 4 airports can meet development and O&M costs with four-mill levies.

d. Only 1 airport requires five mills to cover financial needs for the initial period 1974-1977. With bond financing extending 10 years, the four-mill levy can produce adequate funds.

e. 6 airports immediately require new financing sources. Special legislation may be required at the municipal level to provide enough funds to meet projected facility requirements. The 6 airports require levies of more than six mills.

It can be concluded from the above financial analysis of local airport funding needs that, if 50 per cent State participation in the non-Federal local portion of the costs of airport development can be assured, and if tax revenues can be accumulated, then an airport levy of up to 4 mills will be sufficient. The six airports which require more than 6-mill levies can defray the development needs by bond financing over 15 years with 4-mill levies. Therefore, the maximum airport mill levy recommended is 4 mills.

The mill levy required, however, will in fact be lower than 4 mills for most counties and cities. It is proposed, therefore, that actual mill levies be determined individually at a point within the 4-mill levy limit, so that revenues will not exceed funds needed for airport maintenance and operation costs, as well as the 50 per cent share of the non-Federal portion of development costs.

IMPLEMENTATION

VI. IMPLEMENTATION

A. INTRODUCTION

In the previous chapter, the two funding plans summarized (Alternatives 1 and 2) are based on the assumption that there would be adequate Federal funds to match the combined State and local-government funds. The present chapter recommends a third funding plan, Alternative 3, for implementing the proposed Montana State Airport System Program. This Plan, a representative and more realistic alternative at this time, was selected from a multitude of possible plans which can be devised by varying the timing phases for conducting required facility development projects with the corresponding financing from Federal aid funds and the State and local-government matching funds. Legislative, environmental, and physical constraints on the Plan are also summarized in this chapter.

B. IMPLEMENTATION PLAN

This Plan, Alternative 3, assumes that adequate Federal funds would not be available, even if State and local-government matching funds are provided. Specifically, Alternative 3 is presented under the assumption that the current level of Federal funds made available to the State of Montana would remain constant throughout the entire period to be covered by the Plan. Currently, $1,900,000 and $600,000 are allocated, on an annual basis, to air-carrier and general-aviation airports respectively in the State.

The Implementation Plan is based on the adoption of project priorities considered under Alternative 2 in the previous chapter (and detailed in Chapter VII of the Technical Supplement). This Plan is derived from an iterative process of balancing Federal funds required with the Federal funds available (Table VI-1) by shifting recommended airport

TABLE VI-1

SUMMARY RESULTS OF IMPLEMENTATION PLAN
UNDER ALTERNATIVE 3

(in millions of dollars)

Period \ Airports	Federal Funds Available		Federal Funds Required	
	Air Carrier	General Aviation	Air Carrier	General Aviation
1974-77	7.60	2.40	7.60	2.34
1978-82	9.50	3.00	9.49	2.99
1983-92	19.00	6.00	19.77	3.03

development projects under Alternative 1 from one phase to another successively. One exception made to this shifting process is that development plans already adopted by master plan studies—namely, for Bozeman, Great Falls, and Missoula— are incorporated without changes as their plans are already in the implementation stage. For both air-carrier and general-aviation airport categories, the Federal funds required closely match those available for the short-, intermediate-, and long-range periods, with the exception that there is more than $770,000 required over the total available during the 1983-92 period. Since the emphasis is placed on development plans during the short and intermediate periods, no attempt is made to isolate facility items which may be planned after 1992. General-aviation airport development funding requirements for the forecast periods shown in the table are well within the current level of Federal aid when spread over the entire period (1974-92).

The detailed plan for item-by-item project implementation for each airport and time stage for all air-carrier and general-aviation airports owned and operated by the State and by municipalities is presented in Chapter VII of the Technical Supplement.

As far as State and local financing plans are concerned, recommendations made under Alternatives 1 and 2 still apply. These are mainly based on the facts that the State of Montana requires additional funds to aid airports under the MSASP and that the local government's required maximum mill levy is still 4 mills, because there is a minority of airports which require financing over 10 to 15 years with 4-mill levies, as indicated in the previous chapter. Though it has been noted that the overall revenues to the State expected in 20 years (Chapter V) will exceed one-half of the local funds required for the capital expenditure program, it is recommended that the taxes be reviewed every five years to assure that the levies accruing to the State match the need but do not exceed it. The scope of the financing plan should be confined to 10-year periods. Because of changing technology, a review of forecasts and plans, revenues and costs should be made at least every five years.

C. LEGISLATIVE CONSTRAINTS

The recommendations for implementation of the State Airport System Plan with a State airport development aid program for public airports would require legislative action by the State of Montana. It is recommended that this be done, in order to: (1) provide the matching funds needed to effectively utilize the monies now being collected by the Federal government and allocated to the State for the Federal Airport Development Aid Program; and (2) assure the continuing compatibility of the airports and the communities.

The recommended State legislative actions required to meet the financial needs of the State Airport System Plan (as discussed in Chapter IV) and the other needs outlined above are summarized as follows:

1. Adopt a program of State aid for airport development which would provide grants to local governments of up to one-half of the local funds required.

This program could be financed by revenues if they can be accumulated for up to ten years, under the following provisions:

a. Increase the current State aviation-fuel tax from one cent to two cents per gallon.

b. Collect at the State level all revenues from personal property taxes on aircraft, and use these funds for local airport development.

2. Increase the authorized tax levy for establishment and operation of airports, by counties, cities or towns, from two mills to four mills; and permit up to ten years of funds to be accumulated.

3. Provide for land-use zoning around airports.

This latter item recommended for legislative action by the State is to provide for land-use zoning around airports to assure both continued utility of the airport and its compatibility with the surrounding community. This matter is similar to hazard zoning now in effect, which makes possible legislation to allow local government to provide zoning for protecting the airport's airway approaches from obstructions. The environmental impact of an airport on its surrounding communities should be included as a subject related to land-use zoning considerations so as to assure the continued compatibility of the airport with the community.

D. ENVIRONMENTAL CONSTRAINTS

Few airports in the recommended Montana State Airport System Plan have serious environmental problems; but to assure the continued utility of the airport, the environmental aspect must be given careful study and evaluation. Specific problems are discussed in Appendix I. It is important to note that land acquisition and land-use zoning have been recommended both for airports that are now sensitive and for other airports which are expected to become sensitive, in order to prevent incompatible land uses from developing. The importance of this recommendation of the Implementation Plan cannot be overemphasized. The master planning for each airport must thoroughly consider future environmental impacts. The opportunity is great at most airports in Montana to secure adequate land by fee acquisition or easement, or to obtain proper land-use zoning to avoid encroachment on presently vacant land which could become a detriment to airport development if incompatible activities arise on that land.

E. PHYSICAL CONSTRAINTS

Because of mountainous terrain, some airports are confronted with severe physical constraints, resulting in high landing minima and reduced service reliability. Detailed master planning and site-selection studies for airports requiring use under instrument meteorological conditions should include a complete analysis of the annual and monthly wind and weather pattern with respect to ceiling and visibility minima. This analysis will provide the basic data to establish the requirements for landing aids and assure annual utility at the level required for effectively meeting the aeronautical need.

Some physical constraints which lower current operating minima can be overcome by developing approach procedures that would allow lower landing minima than are possible with the application of the standard FAA criteria. This can be accomplished by having airport owners in cooperation with scheduled air-carrier owners supply the FAA with

substantive facts. The FAA can then be petitioned to review the procedures in effect and thereby possibly enable it to establish new procedures that would allow lower landing minima for selected aircraft. The result will be an increase in reliability of scheduled airline service. To accomplish these ends, it would be preferable to institute special studies during the master planning stage.

For a number of Montana airports, future airport requirements disclose physical limitations that are related to the land area available for the development of runway, passenger terminal, and hangar facilities. For these airports, detailed master planning is required and must consider the long-term requirements to assure that investments being made in near-term facilities can be expanded to meet 1992 requirements.